<u>IN THE CLAIMS</u>:

Claims 1, 2, 27, 28, 35, 39 and 45 have been amended herein. Please note that all claims currently pending and under consideration in the referenced application are shown below. Please enter these claims as amended. This listing of claims will replace all prior versions and listings of claims in the application.

<u>Listing of Claims</u>:

1. (Currrently Amended) A <u>machine-implemented</u> method for simulating the placement of a plurality of unplaced particles, the method comprising:

selecting a plurality of unplaced particles;

wherein each of the plurality of unplaced particles exhibits a characteristic dimension, corresponding to N categories of the plurality of unplaced particles;

wherein the characteristic dimension of each of the plurality of unplaced particles of a given category of the N categories is different from the characteristic dimension of each of the plurality of unplaced particles of other of the N categories;

defining a central string, a space disposed about the central string, and N subspaces disposed about the central string and within the space, wherein each of the N subspaces corresponds to one of the N categories, respectively;

selecting a particle from the plurality of unplaced particles;

defining a catch net representative of buoyancy of a portion of a plurality of placed particles and positioning the catch net within the space based upon the placement of the portion of the plurality of placed particles;

defining a water level representative of a level of a portion of the plurality of placed particles that are smaller than the selected particle;

simulating placement of the selected particle within a corresponding subspace so that the selected particle is positioned in a non-overlapping relationship with respect to the plurality of placed particles, the catch net, and the water level; and

repeatedly selecting another particle from the plurality of unplaced particles and simulating placement thereof until placement of each of the plurality of unplaced particles has been

simulated.

2. (Currently Amended) A machine-implemented method for simulating the placement of a plurality of unplaced particles, the method comprising:

selecting a plurality of unplaced particles;

wherein each of the plurality of unplaced particles exhibits a characteristic dimension, corresponding to N categories of the plurality of unplaced particles;

wherein the characteristic dimension of each of the plurality of unplaced particles of a given category of the N categories is different from the characteristic dimension of each of the plurality of unplaced particles of other of the N categories;

defining a central string, a space disposed about the central string, and N subspaces disposed about the central string and within the space, wherein each of the N subspaces corresponds to one of the N categories, respectively;

selecting a particle from the plurality of unplaced particles;

defining a catch net representative of a buoyancy of a portion of a plurality of placed particles and positioning the catch net within the space based upon the placement of the portion of the plurality of placed particles;

simulating placement of the selected particle withina corresponding subspace so that the selected particle is positioned in a non-overlapping relationship with respect to the plurality of placed particles and the catch net; and

repeatedly selecting another particle from the plurality of unplaced particles and simulating placement thereof until placement of each of the plurality of unplaced particles has been simulated.

3. (Previously Presented) The method as recited in claim 2, wherein each of the plurality of unplaced particles comprises a sphere and the characteristic dimension of each of the plurality of unplaced particles comprises a radius.

4. (Previously Presented) The method as recited in claim 2, wherein selecting the particle from the plurality of unplaced particles comprises randomly selecting the particle from

the plurality of unplaced particles.

5. (Previously Presented) The method as recited in claim 2, further comprising:
defining a pack surface for the plurality of placed particles; and
positioning the catch net relative to a position of the pack surface.

6. (Previously Presented) The method as recited in claim 5, wherein positioning the catch net relative to the pack surface comprises positioning the catch net at a distance away from the pack surface based upon a selected particle radius.

7. (Previously Presented) The method as recited in claim 5, wherein:
the plurality of placed particles include a top layer; and
the position of the pack surface comprises an average of a particle location of each of the plurality of placed particles in the top layer thereof.

8. (Previously Presented) The method as recited in claim 5, wherein:
each of the plurality of placed particles has a south pole;
the plurality of placed particles include a top layer; and
the pack surface corresponds to the south poles of the top layer placed particles.

9. (Previously Presented) The method as recited in claim 8, wherein the pack surface corresponds to an average of the south pole positions of each of the plurality of placed particles of the top layer.

10. (Previously Presented) The method as recited in claim 2, wherein:
the catch net extends across the space substantially perpendicularly to the central string.

11. (Previously Presented) The method as recited in claim 2, wherein:
the catch net extends across each of the subspaces substantially perpendicularly to the central string.

12. (Previously Presented) The method as recited in claim 2, wherein:
each of the subspaces extends substantially perpendicularly to the central string;
the catch net comprises N subnets; and
each of the N subnets corresponds to each of the N subspaces, respectively.

13. (Previously Presented) The method as recited in claim 12, wherein each of the N subnets extends across a corresponding subspace of the N subspaces.

14. (Previously Presented) The method as recited in claim 13, wherein:
each of the N subnets has a level; and
the levels of at least two of the N subnets differ from one another.

15. (Previously Presented) The method as recited in claim 14, wherein positioning the catch net comprises positioning each of the N subnets at a selected distance from an end of the central string.

16. (Previously Presented) The method as recited in claim 2, wherein:
the space includes a base surface; and
positioning the catch net comprises spacing the catch net away from the base surface.

17. (Previously Presented) The method as recited in claim 16, wherein spacing the catch net away from the base surface simulates a positioning of the catch net for a top layer of the placed particles.

18. (Previously Presented) The method as recited in claim 2, wherein positioning the catch net comprises:
positioning the catch net for a k_{th} one of the particle categories at a catch net position $Z_{net}(k)$ within a k_{th} one of the subspaces determined by $Z_{net}(k) = Z_{init} + H\ r\ a_k\ a_{min}/a_{max}$;

wherein:

Z_{init} is an initial catch net position for a k_{th} one of the N subspaces;

a_k is a characteristic dimension of the particles of a k_{th} one of the particle categories;

a_{min} is a characteristic dimension of a small one of the particles;

a_{max} is a characteristic dimension of a large one of the particles;

r is a weighting coefficient; and

H is a switching coefficient.

19. (Previously Presented) The method as recited in claim 18, wherein the weighting coefficient is assigned a random number.

20. (Previously Presented) The method as recited in claim 18, wherein:

below a threshold value the switching coefficient is assigned a value of one; and

above the threshold value the switching coefficient is assigned a value of zero.

21. (Previously Presented) The method as recited in claim 5, wherein the pack surface defining comprises:

selecting a top layer of the placed particles;

for each particle category k of the placed particles in the top layer, defining a particle radius a_i for the placed particles i of that category k;

for the subspace k corresponding to the particle category k, assigning a cylinder radius W_k;

assigning a top layer particle number m(k) and determining values for m(k) by evaluating

$$\sum_{\substack{i=1 \\ Submode(i)\le k}}^{m(k)-1} a_i^2 < W_k^2 \le \sum_{\substack{i=1 \\ Submode(i)\le k}}^{m(k)} a_i^2 \ , \ k=1,2,\ldots,N$$

where N is the number of particle categories; and

determining the pack surface location using

$$S = \frac{1}{m}\sum_{i=1}^{m}(Z_i - a_i)$$

where S represents the pack surface and Z_i represents the position of a center of a center one of the placed spheres.

22. (Previously Presented) The method as recited in claim 5, wherein:

for a given particle category k and corresponding subspace k, the particle placement comprises contacting an ith placed particle with the selected particle, the ith placed particle having the characteristic dimension a_i and the selected particle having the characteristic dimension a_c;

the catch net comprises a subnet corresponding to the subspace k; and

if $a_i/a_c<1$, then the catch net positioning comprises positioning the subnet k for the kth subspace $Z_{net}(k)$ at

$$Z_{net}(k) = S - a_i$$

where S represents the position of the pack surface.

23. (Previously Presented) The method as recited in claim 5, wherein:

for a given particle category k and corresponding subspace k, the particle placement comprises contacting an ith placed particle with the selected particle, the ith placed particle having the characteristic dimension a_i and the selected particle having the characteristic dimension a_c;

the catch net comprises a subnet corresponding to the subspace k; and

if $1 \leq a_i/a_c < a_x$, where a_x represents a sample particle size for a corresponding sample particle that will fit into a cavity formed by placed spheres larger than the sample particle, then the catch net positioning comprises positioning the subnet k for the kth subspace $Z_{net}(k)$ at

$$Z_{net}(k) = S - 2a_c$$

where S represents the position of the pack surface.

24. (Previously Presented) The method as recited in claim 23, wherein the sample

particle size a_x is assigned a value of $\sqrt{6} + 2$.

25. (Previously Presented) The method as recited in claim 5, wherein:

for a given particle category k and corresponding subspace k, the particle placement comprises contacting an ith placed particle with the selected particle, the ith placed particle having the characteristic dimension a_i and the selected particle having the characteristic dimension a_c;

the catch net comprises a subnet corresponding to the subspace k; and

if $a_i/a_c \geq a_x$, where a_x represents a sample particle size for a corresponding sample particle that will fit into a cavity formed by placed spheres larger than the sample particle, then the catch net positioning comprises positioning the subnet k for the kth subspace $Z_{net}(k)$ at

$$Z_{net}(k) = S - 2a_c - a_i$$

where S represents the position of the pack surface.

26. (Previously Presented) An apparatus for simulating placement of a plurality of unplaced particles, comprising:

an input device for inputting particle selection information;

a storage device operatively coupled to the input device for storing the particle selection information; and

a processor for repeatedly selecting a particle from the plurality of unplaced particles, for simulating placement of the selected particle within a space in a non-overlapping relationship with respect to previously placed particles to form a plurality of placed particles, and for establishing a catch net representative of buoyancy of a portion of the plurality of placed particles and positioning the catch net within a space based upon the placement of the portion of the plurality of placed particles, the processor configured for placing the selected particle in non-overlapping relationship with respect to the catch net.

27. (Previously Presented) A machine-readable medium for use in ~~placing~~ simulating the placement of a plurality of unplaced particles, comprising:

machine executable instructions for defining a central string, a space disposed about the central string, and N subspaces disposed about the central string and within the space, each of the N subspaces corresponding to one of N categories of the plurality of particles, wherein each of the N categories corresponds to a characteristic dimension of the plurality of unplaced particles;

wherein the machine executable instructions are configured for repeatedly selecting a particle from the plurality of unplaced particles and simulating placement of the selected particle in a subspace of the N subspaces corresponding to the one category of N categories in a non-overlapping relationship with previously placed particles, to form a plurality of placed particles; and

wherein the machine executable instructions are configured for defining a catch net representative of buoyancy of a portion of the plurality of placed particles and positioning the catch net within the space based upon the placement of the portion of the plurality of placed particles, the selected particle being placed in non-overlapping relation with respect to the catch net.

28. (Currently Amended) A machine-implemented method for simulating placement of a plurality of particles, the method comprising:

selecting a plurality of unplaced particles;

wherein each of the plurality of unplaced particles exhibits a characteristic dimension, corresponding to N categories of the plurality of unplaced particles;

wherein the characteristic dimension of each of the plurality of unplaced particles of a given category of the N categories is different from the characteristic dimension of each of the plurality of particles of other of the N categories;

defining a central string, a space disposed about the central string, and N subspaces disposed about the central string and within the space, wherein each of the N subspaces corresponds to one of the N categories;

selecting a particle from the plurality of unplaced particles;

defining a water level representative of a level of a portion of a plurality of placed particles that are smaller than the selected particle;

simulating placement of the selected particle within a corresponding subspace so that the selected particle is positioned in a non-overlapping relationship with respect to the plurality of placed particles and the water level; and

repeatedly selecting another particle from the plurality of unplaced particles and simulating placement thereof until each of the particles of the plurality of unplaced particles has been simulated.

29. (Previously Presented) The method as recited in claim 28, wherein each of the plurality of unplaced particles comprises a sphere and the characteristic dimension of each of the plurality of unplaced particles comprises a radius.

30. (Previously Presented) The method as recited in claim 28, wherein:

positioning the water level comprises determining an average location of the particle locations along the central string of the plurality of placed particles and positioning the water level at the average location.

31. (Previously Presented) The method as recited in claim 28, wherein:

the water level comprises a plurality of subspace water levels wherein each of the plurality of subspace water levels corresponds to one of the N subspaces, respectively; and

positioning the water level comprises positioning each of the plurality of subspace water levels.

32. (Previously Presented) The method as recited in claim 31, wherein:

each of the N subspaces comprises a subspace surface representative of a portion of placed particles therein, each of the subspace surfaces comprising a subspace surface location with respect to the central string;

each of the plurality of placed particles comprises a north pole having a north pole location; and

the subspace water level position for one of the subspaces is determined by determining an average location of the north pole locations of the portion of the plurality of placed particles within the one subspace and assigning the average location of the subspace surface location for the one subspace.

33. (Previously Presented) The method as recited in claim 31, wherein:

each of the N subspaces comprises a subspace surface representative of a portion of the smaller placed particles within that subspace, each of the subspace surfaces comprising a subspace surface location with respect to the central string;

each of the plurality of placed particles comprises a south pole having a south pole location; and

the subspace water level position for one of the subspaces is determined by determining an average location of the south pole locations of the portion of the plurality of placed particles within the one subspace and assigning the average location as the subspace surface location for the one subspace.

34. (Previously Presented) The method as recited in claim 28, wherein:

positioning the water level comprises using an offset to position the water level.

35. (Currently Amended) ~~A~~ The method as recited in claim 31, wherein:

positioning the water level comprises using an offset for each of the subspace water level positions.

36. (Previously Presented) An apparatus for simulating placement of a plurality of unplaced particles, comprising:

an input device for inputting particle selection information;

a storage device operatively coupled to the input device for storing the particle selection information; and

a processor for selecting a particle from the plurality of particles, for placing the selected particle in the corresponding subspace so that the selected particle becomes a placed particle at a particle location unique to that placed particle and is in non-overlapping relation with other placed particles, for establishing a water level representative of a level of a portion of the placed particles that are smaller than the selected particle and represent a surface of the smaller placed particles, and for positioning the water level within the space based upon the smaller particle surface, the selected particle being placed in non-overlapping

relation with respect to the water level.

37. (Previously Presented) A machine-readable medium for use in simulating placement of plurality of unplaced particles, comprising:

machine executable instructions for defining a central string, a space disposed about the central string, and N subspaces disposed about the central string and within the space, each of the N subspaces corresponding to one of the N particle categories;

wherein the machine executable instructions are configured for repeatedly selecting a particle from the plurality of particles and simulating the placement of the selected particle in a subspace of the N subspaces of the corresponding category of N categories in non-overlapping relation with previously placed particles, to form a plurality of placed particles; and

wherein the machine executable are configured for defining a water level representative of a portion of the plurality of placed particles that are smaller than the selected particle and represent a surface of the portion of the plurality of placed particles and for positioning the water level within the space based upon the smaller particle surface, the selected particle being placed in non-overlapping relation with respect to the water level.

38. (Previously Presented) The method as recited in claim 1, wherein the N subspaces each comprise a cylindrical subspace positioned concentrically with respect to the central string.

39. (Currently Amended) A <u>machine-implemented</u> method for simulating the placement of a particle, the method comprising:

defining a central string and a space having a cylindrical boundary wall disposed about the central string;

defining a plurality of cylindrical subspaces disposed about the central string and within the space, wherein each of the subspaces has a cylindrical boundary wall;

wherein the space includes a plurality of previously placed particles;

defining a water level representative of a level of a portion of the plurality of previously placed particles having a size which is smaller than the selected particle;

simulating movement of a particle within the space from an initial position and in a selected direction;

simulating contact of the particle with at least one of the cylindrical wall of the space, the water level, the cylindrical wall of one of the plurality of subspaces, and at least one of the plurality of previously placed particles; and

determining stable placement of the particle within the space.

40. (Previously Presented) The method as recited in claim 39, wherein simulating contact of the particle with at least one of the cylindrical wall of the space, the water level, the cylindrical wall of one of the plurality of subspaces, and the at least one of the plurality of previously placed particles comprises simulating rolling of the particle with respect to at least one of the cylindrical wall of the space, the water level, the cylindrical wall of one of the plurality of subspaces, and the at least one of the plurality of previously placed particles.

41. (Previously Presented) The method as recited in claim 39, wherein simulating contact of the particle with at least one of the cylindrical wall of the space, the water level, the cylindrical wall of one of the plurality of subspaces, and the at least one of the plurality of previously placed particles comprises determining whether contact of the particle with at least one of the cylindrical wall of the space, the water level, the cylindrical wall of one of the plurality of subspaces, and the at least one of the plurality of previously placed particles is compressive or tensile.

42. (Previously Presented) The method as recited in claim 39, wherein simulating movement of the particle within the space from the initial position and in the selected direction comprises simulating movement of the particle within the space in a direction parallel to the central string.

43. (Previously Presented) The method as recited in claim 39, wherein simulating movement of the particle within the space from the initial position and in the selected direction comprises constraining a center of the particle to remain within one of the plurality of cylindrical

subspaces during simulating movement thereof.

44. (Previously Presented) The method as recited in claim 39, further comprising:

defining a catch net representative of buoyancy of a portion of the plurality of placed particles and positioning the catch net within the space based upon the placement of the portion of the plurality of placed particles.

45. (Currently Amended) A <u>machine-implemented</u> method for simulating the placement of a particle, the method comprising:

defining a central string and a space having a cylindrical boundary wall disposed about the central string;

defining a plurality of cylindrical subspaces disposed about the central string and within the space, wherein each of the subspaces has a cylindrical boundary wall;

wherein the space includes a plurality of previously placed particles;

defining a catch net representative of a buoyancy of a portion of the plurality of previously placed particles and positioning the catch net within the space based upon the placement of the portion of the plurality of previously placed particles;

simulating movement of a particle within the space from an initial position and in a selected direction;

simulating contact of the particle with at least one of the cylindrical wall of the space, the catch net, the cylindrical wall of one of the plurality of subspaces, and at least one of the plurality of previously placed particles; and

determining stable placement of the particle within the space.

46. (Previously Presented) The method as recited in claim 46, wherein simulating contact of the particle with at least one of the cylindrical wall of the space, the catch net, the cylindrical wall of one of the plurality of subspaces, and the at least one of the plurality of previously placed particles comprises simulating rolling of the particle with respect to at least one of the cylindrical wall of the space, the catch net, the cylindrical wall of one of the plurality of subspaces, and the at least one of the plurality of previously placed particles.

47. (Previously Presented) The method as recited in claim 46, wherein simulating contact of the particle with at least one of the cylindrical wall of the space, the catch net, the cylindrical wall of one of the plurality of subspaces, and the at least one of the plurality of previously placed particles comprises determining whether contact of the particle with at least one of the cylindrical wall of the space, the catch net, the cylindrical wall of one of the plurality of subspaces, and the at least one of the plurality of previously placed particles is compressive or tensile.

48. (Previously Presented) The method as recited in claim 46, wherein simulating movement of the particle within the space from the initial position and in the selected direction comprises simulating movement of the particle within the space in a direction parallel to the central string.

49. (Previously Presented) The method as recited in claim 46, wherein simulating movement of the particle within the space from the initial position and in the selected direction comprises constraining a center of the particle to remain within one of the plurality of cylindrical subspaces during simulating movement thereof.

50. (Previously Presented) The method as recited in claim 46, further comprising:
defining a water level representative of a level of a portion of the plurality of previously placed particles having a size which is smaller than the selected particle.